# 6-03 STEEL STRUCTURES

## 6-03.1 Description

This Work consists of furnishing, fabricating, erecting, cleaning, and painting steel Structures and the structural steel parts of nonsteel Structures

## 6-03.2 Materials

Materials shall meet the requirements of the following sections:

| | |
|---|---|
| Structural Steel and Related Materials | 9-06 |
| Paints | 9-08 |

Structural steel shall be classified as:

1. Structural carbon steel (to be used whenever the Plans do not specify another classification),
2. Structural low alloy steel, and
3. Structural high strength steel.

Unless the Plans or Special Provisions state otherwise, the following shall be classified as structural carbon steel: shims; ladders; stairways; anchor bolts and sleeves; pipe, fittings and fastenings used in handrails; and other metal parts, even if made of other materials, for which payment is not specified.

All AASHTO M 270 material used in what the Plans show as main load-carrying tension members or as tension components of flexural members shall meet the Charpy V-notch requirements of AASHTO M 270 temperature zone 2. All AASHTO M 270 material used in what the Plans show as fracture critical members shall meet the Charpy V-notch requirements of AASHTO M 270, Fracture Critical Impact Test Requirements, temperature zone 2. Charpy V-notch requirements for other steel materials shall be as specified in the Plans and Special Provisions.

The Contractor shall submit for the Engineer's approval a written plan for visibly marking the material so that it can be traced. These marks shall remain visible at least through the fit-up of the main load-carrying tension members. The marking method shall permit the Engineer to verify: (1) material Specification designation, (2) heat number, and (3) material test reports to meet any special requirements.

For steel in main load-carrying tension members and in tension components of flexural members, the Contractor shall include the heat numbers on the reproducible copies of the as-built shop plans.

## 6-03.3 Construction Requirements

Structural steel fabricators of girders, floorbeams, truss members, and stringers, for permanent steel bridges, shall be certified under the AISC Quality Certification Program, Major Steel Bridges Category. When fracture critical members are specified in the Contract, structural steel fabricators shall also have an endorsement F, Fracture Critical, under the AISC Quality Certification Program.

### 6-03.3(1) Vacant

### 6-03.3(2) Facilities for Inspection

The Contractor shall provide all facilities the Inspector requires to inspect material and workmanship. Inspectors shall be given safe and free access to all areas in the mill and shop.

### 6-03.3(3) Inspector's Authority

The Inspector may reject materials or workmanship that does not comply with these Specifications. In any dispute, the Contractor may appeal to the Engineer whose decision shall be final.

By its inspection at the mill and shop, the Contracting Agency intends only to facilitate the Work and prevent errors. This inspection shall not relieve the Contractor of any responsibility for identifying and replacing defective material or workmanship.

### 6-03.3(4) Rejections

Even if the Inspector accepts materials or finished members, the Contracting Agency may later reject them if defective. The Contractor shall promptly replace or make good any rejected materials or workmanship.

### 6-03.3(5) Mill Orders and Shipping Statements

The Contractor shall furnish as many copies of mill orders and shipping statements as the Engineer requires.

### 6-03.3(6) Weighing

Structural steel need not be weighed unless the Plans or Special Provisions require it. When a weight is required, it may either be calculated or obtained by scales. The Contractor shall furnish as many copies of the calculations or weight slips as the Engineer requires. If scale weights are used, the Contractor shall record separately the weights of all tools, erection material, and dunnage.

### 6-03.3(7) Shop Plans

The Contractor shall submit for approval all shop detail plans for fabricating the steel. These shall be sent to the Department of Transportation Bridge and Structures Engineer, Construction Support, addressed as follows:

If sent via US Postal Service:

Washington State Department of Transportation
Bridge and Structures Engineer
Construction Support
P. O. Box 47340
Olympia, WA 98504-7340

If sent via FedEx:

Washington State Department of Transportation
Bridge and Structures Engineer
Construction Support
7345 Linderson Way SW
Tumwater, WA 98501-6504

If these plans will be submitted directly from the fabricator, the Contractor shall so notify the Project Engineer in writing.

Prints of the plans shall be supplied in these quantities:

1. Eight sets to the Bridge and Structures Engineer (4 more sets are required for each affected railroad company on any grade separation Structure that carries a railroad over a Highway), and
2. Two sets to the Project Engineer.

The Bridge and Structures Engineer will return the plans to the Project Engineer, who will forward copies to the Contractor. If any sheets require correction, the Contractor shall correct and resubmit them in the quantities required above. No material shall be fabricated until: (1) the Bridge and Structures Engineer has approved the plans, and (2) the State Materials Engineer has approved the materials source and the fabricator.

In approving shop plans, the Contracting Agency accepts only the nature and scope of the details without validating any dimensions.

Unless the Engineer permits it in writing, no changes shall be made in any drawing after its approval.

Before physical completion of the project, the Contractor shall furnish the Project Engineer 1 set of reproducible copies of the as-built shop plans. (One more set is required for each affected railroad company on any grade separation Structure that carries a railroad over a Highway.) The reproducible copies shall be clear, suitable for microfilming, and on permanent sheets that measure no smaller than 11 by 17-inches. Alternatively, the shop drawings may be provided in an electronic format with the approval of the Bridge and Structures Engineer.

### 6-03.3(7)A Erection Methods

Before beginning to erect any steel Structure, the Contractor shall submit to the Engineer for review and shall have received approval for the erection plan and procedure describing the methods the Contractor intends to use. The Contractor's erection plan and procedure shall be reviewed by the steel fabricator prior to being submitted to the Engineer. The Contractor shall submit evidence that the fabricator has reviewed the erection plans and procedure; and submit the fabricator's review comments to the Engineer along with the erection plan submittal.

The erection plan and procedure shall provide complete details of the erection process including but not limited to:

1. Temporary falsework support, bracing, guys, deadmen, and attachments to other Structure components or objects;
2. Procedure and sequence of operation;
3. Girder stresses during progressive stages of erection;
4. Girder masses , lift points, and lifting devices, spreaders, glommers, etc.;
5. Crane(s) make and model, mass, geometry, lift capacity, outrigger size and reactions;
6. Girder launcher or trolley details and capacity (if intended for use); and
7. Locations of cranes, barges, trucks delivering girders, and the location of cranes and outriggers relative to other Structures, including retaining walls and wing walls.

The erection plan shall include drawings, notes, catalog cuts, and calculations clearly showing the above listed details, assumptions, and dimensions. Material properties, Specifications, structural analysis, and any other data used shall also be included. The plan shall be prepared by (or under the direct supervision of) a Professional Engineer, licensed under Title 18 RCW, State of Washington, in the branch of Civil or Structural, and shall carry the engineer's seal and signature, in accordance with Section 6-02.3(16).

The Contractor shall submit the erection plans, calculations, procedure, and fabricator's comments directly to the Bridge and Structures Office, Construction Support Engineer, in accordance with Section 6-02.3(16). After the plan is approved and returned to the Contractor, all changes that the Contractor proposes shall be submitted to the Project Engineer for review and approval.

### 6-03.3(8) Substitutions

The Contractor shall not substitute sections that differ from Plan dimensions unless the Engineer approves in writing. If the Contractor requests and receives approval to substitute heavier members, the Contracting Agency shall not pay any added cost.

### 6-03.3(9) Handling, Storing, and Shipping of Materials

Markings applied at the mill shall distinguish structural low alloy steel from structural carbon steel. The fabricator shall keep the 2 classes of steel carefully separated.

Before fabrication, all material stored at the fabricating plant shall be protected from rust, dirt, oil, and other foreign matter. The Contracting Agency will accept no rust-pitted material.

After fabrication, all material awaiting shipment shall be subject to the same storage requirements as unfabricated material.

All structural steel shall arrive at the job in good condition. As the Engineer requires, steel damaged by salt water shipment shall be thoroughly cleaned by high pressure water flushing, chemical cleaning, or sandblasting, and repainted with the specified shop coat.

All material shall be stored so as to prevent rust and loss of small parts. Piled material shall not rest on the ground or in water but on skids or platforms.

The loading, transporting, unloading, and piling of the structural steel material shall be so conducted that the metal will be kept clean and free from injury from rough handling.

In field assembly of structural parts, the Contractor shall use methods and equipment not likely to twist, bend, deform, or otherwise injure the metal. Any member slightly bent or twisted shall be corrected before it is placed. The Contracting Agency will reject any member with serious handling damage.

Girder sections shall be handled so as to prevent damage to the girders. If necessary, the Contractor shall provide temporary stiffeners to prevent buckling during erection.

### 6-03.3(10) Straightening Bent Material

If the Engineer permits in writing, plates, angles, other shapes, and built-up members may be straightened. Straightening methods shall not fracture or injure the metal. Distorted members shall be straightened mechanically. A limited amount of localized heat may be applied only if carefully planned and supervised, and only if the Engineer has approved a heat-straightening procedure in writing.

Parts to be heat-straightened shall be nearly free from all stress and external forces except those that result from the mechanical pressure used with the heat.

After straightening, the Contractor will inspect the member for fractures using a method determined by the Contracting Agency.

The Contracting Agency will reject metal showing sharp kinks and bends.

The procedure for heat straightening of universal mill (UM) plates by the mill or the fabricator shall be submitted to the Engineer for approval.

### 6-03.3(11) Workmanship and Finish

Workmanship and finish shall be first-class, equaling the best practice in modern bridge fabrication shops. Welding, shearing, burning, chipping, and grinding shall be done neatly and accurately. All parts of the Work exposed to view shall be neatly finished.

Wherever the Plans show a surface finish symbol, the surface shall be machined.

### 6-03.3(12) Falsework

All falsework shall meet the requirements of Section 6-02.

### 6-03.3(13) Fabricating Tension Members

Plates for main load-carrying tension members or tension components of flexural members shall be:

1. Blast cleaned entirely or blast cleaned on all areas within 2-inches of welds to SSPC-SP6, Commercial Blast Cleaning, and
2. Fabricated from plate stock with the primary rolling direction of the stock parallel to the length of the member.

### 6-03.3(14) Edge Finishing

All rolled, sheared, and thermal cut edges shall be true to line and free of rough corners and projections. Corners along exposed sheared or cut edges shall be broken by light grinding or another method approved by the Engineer to achieve an approximate $\frac{1}{16}$-inch chamfer or rounding.

Sheared edges on plates more than $\frac{5}{8}$-inch thick shall be planed, milled, ground, or thermal cut to a depth of at least $\frac{1}{8}$-inch.

Re-entrant corners or cuts shall be filleted to a minimum radius of 1-inch.

Exposed edges of main load-carrying tension members or tension components of flexural members shall have a surface roughness no greater than 250-micro-inches as defined by the American National Standards Institute, ANSI B46.1, Surface Texture. Exposed edges of other members shall have surface roughness no greater than 1,000-micro-inches.

The Rockwell hardness of thermal-cut edges of structural low alloy or high-strength steel flanges, as specified in Section 9-06.2 and 9-06.3, for main load-carrying tension members or tension components of flexural members shall not exceed RHC 30. The fabricator shall prevent excessive hardening of flange edges through preheating, post heating, or control of the burning process as recommended by the steel manufacturer and approved by the Engineer.

Hardness testing shall consist of testing thermal-cut edges with an approved portable hardness tester. The hardness tester, and it's operating test procedures, shall be submitted to the Engineer for approval prior to use. The hardness tester shall be convertible to Rockwell C scale values.

At 2 locations, 2 tests shall be performed on each thermal-cut edge, 1 each within $\frac{1}{4}$-inch of the top and bottom surfaces. The tests shall be located $\frac{1}{4}$-the length of each thermal-cut edge from each end of the cut. If 1 or more readings are greater than RHC 30, the entire length of the edge shall be ground or machined to a depth sufficient to provide acceptable readings upon further retests. If thermal-cutting operations conform to procedures approved by the Engineer, and hardness testing results are consistently within acceptable limits, the Engineer may approve a reduction in the testing frequency.

### 6-03.3(15) Planing of Bearing Surfaces

Ends of columns that bear on base and cap plates shall be milled to true surfaces and accurate bevels.

When assembled, caps and base plates of columns and the sole plates of girders and trusses shall have a fit tolerance within $\frac{1}{32}$-inch for 75-percent of the contact area. If warped or deformed, the plates shall be heat straightened, planed, or corrected in some other way to produce accurate, even contact. If necessary for proper contact, bearing surfaces that will contact other metal surfaces shall be planed or milled. Surfaces of warped or deformed base and sole plates that will contact masonry shall be rough finished.

On the surface of expansion bearings, the cut of the planer shall be in the direction of expansion.

### 6-03.3(16) Abutting Joints

Abutting ends of compression members shall be faced accurately so that they bear evenly when in the Structure. On built-up members, the ends shall be faced or milled after fabrication.

Ends of tension members at splices shall be rough finished to produce neat, close joints. A contact fit is not required.

### 6-03.3(17) End Connection Angles

On floorbeams and stringers, end connection angles shall be flush with each other and set accurately in relationship to the position and length of the member. Unless the Plans require it, end connection angles shall not be finished. If, however, faulty assembly requires them to be milled, milling shall not reduce thickness by more than $\frac{1}{16}$-inch.

### 6-03.3(18) Built Members

The various pieces forming one built member shall be straight and close fitting, true to detailed dimensions, and free from twists, bends, open joints, or other defects.

When fabricating curved girders, localized heat or the use of mechanical force shall not be used to bend the girder flanges about an axis parallel to girder webs.

### 6-03.3(19) Hand Holes

Hand holes, whether punched or cut with burning torches, shall be true to sizes and shapes shown in the Plans. Edges shall be true to line and ground smooth.

### 6-03.3(20) Lacing Bars

Unless the Plans state otherwise, ends of lacing bars shall be neatly rounded.

### 6-03.3(21) Plate Girders

### 6-03.3(21)A Web Plates

If web plates are spliced, gaps between plate ends shall be set at shop assembly to measure ¼-inch, and shall not exceed ⅜-inch.

### 6-03.3(21)B Vacant

### 6-03.3(21)C Web Splices and Fillers

Web splice plates and fillers under stiffeners shall fit within ⅛-inch at each end. In lieu of the steel material specified in the Plans or Special Provisions, the Contractor may substitute ASTM A 1008 or ASTM A 1011 steel for all filler plates less than ¼-inch thickness, provided that the grade of filler plate steel meets or exceeds that of the splice plates.

### 6-03.3(22) Eyebars

Eyebars shall be straight, true to size, and free from twists or folds in the neck or head and from any other defect that would reduce their strength. Heads shall be formed by upsetting, rolling, or forging. Dies in use by the manufacturer may determine the shape of bar heads if the Engineer approves. Head and neck thickness shall not overrun by more than 1/16-inch. Welds shall not be made in the body or head of any bar.

Each eyebar shall be properly annealed and carefully straightened before it is bored. Pinholes shall be located on the centerline of each bar and in the center of its head. Holes in bar ends shall be so precisely located that in a pile of bars for the same truss panel the pins may be inserted completely without driving. All eyebars made for the same locations in trusses shall be interchangeable.

### 6-03.3(23) Annealing

All eyebars shall be annealed by being heated uniformly to the proper temperature, then cooled slowly and evenly in the furnace. At all stages, the temperature of the bars shall be under full control.

Slight bends on secondary steel members may be made without heat. Crimped web stiffeners need no annealing.

### 6-03.3(24) Pins and Rollers

Pins and rollers shall be made of the class of forged steel the Plans specify. They shall be turned accurately to detailed dimensions, smooth, straight, and flawless. The final surface shall be produced by a finishing cut.

Pins and rollers 9-inches or less in diameter may either be forged and annealed or made of cold-finished carbon steel shafting.

Pins more than 9-inches in diameter shall have holes at least 2-inches in diameter bored longitudinally through their centers. Pins with inner defects will be rejected.

The Contractor shall provide pilot and driving nuts for each size of pin unless the Plans state otherwise.

### 6-03.3(24)A Boring Pin Holes

Pin holes shall be bored true to detailed dimensions, smooth and straight, and at right angles to the axis of the member. Holes shall be parallel with each other unless the Plans state otherwise. A finishing cut shall always be made.

The distance between holes shall not vary from detailed dimensions by more than 1/32-inch. In tension members, this distance shall be measured from outside to outside of holes; in compression members, inside to inside.

### 6-03.3(24)B Pin Clearances

Each pin shall be 1/50-inch smaller in diameter than its hole. All pins shall be numbered after being fitted into their holes in the assembled member.

### 6-03.3(25) Welding and Repair Welding

Welding and repair welding of all steel bridges shall comply with the AASHTO/AWS D1.5M/D1.5:2002 Bridge Welding Code. Welding and repair welding for all other steel fabrication shall comply with the AWS D1.1/D1.1M, latest edition, Structural Welding Code. The requirements described in the remainder of this section shall prevail whenever they differ from either of the above welding codes.

The Contractor shall weld structural steel only to the extent shown in the Plans. No welding, including tack and temporary welds shall be done in the shop or field unless the location of the welds is shown on the approved shop drawings or approved by the Engineer in writing.

Welding procedures shall be submitted for approval with shop drawings . The procedures shall specify the type of equipment to be used, electrode selection, preheat requirements, base materials, and joint details. When the procedures are not prequalified by AWS or AASHTO, evidence of qualification tests shall be submitted.

Welding shall not begin until after the Contractor has received the Engineer's approval of shop plans as required in Section 6-03.3(7). These plans shall include procedures for welding, assembly, and any heat-straightening or heat-curving.

Any welded shear connector longer than 8-inches may be made of 2 shorter shear connectors joined with full-penetration welds.

In shielded metal-arc welding, the Contractor shall use low-hydrogen electrodes.

In submerged-arc welding, flux shall be oven-dried at 550ºF for at least 2-hours, then stored in ovens held at 250ºF or more. If not used within 4-hours after removal from a drying or storage oven, flux shall be redried before use.

Preheat and interpass temperatures shall conform to the applicable welding code as specified in this section. When welding main members of steel bridges, the minimum preheat shall not be less than 100ºF.

If groove welds (web-to-web or flange-to-flange) have been rejected, they may be repaired no more than twice. If a third failure occurs, the Contractor shall:

1. Trim the members, if the Engineer approves, at least ½-inch on each side of the weld; or
2. Replace the members at no expense to the Contracting Agency.

By using extension bars and runoff plates, the Contractor shall terminate groove welds in a way that ensures the soundness of each weld to its ends. The bars and plates shall be removed after the weld is finished and cooled. The weld ends shall then be ground smooth and flush with the edges of abutting parts.

The Contractor shall not:

1. Weld with electrogas or electroslag methods,
2. Weld nor flame cut when the ambient temperature is below 20ºF, or
3. Use coped holes in the web for welding butt splices in the flanges unless the Plans show them.

### 6-03.3(25)A Welding Inspection

The Contractor's inspection procedures, techniques, methods, acceptance criteria, and inspector qualifications for welding of steel bridges shall be in accordance with the AASHTO/AWS D1.5M/D1.5:2002 Bridge Welding Code. The Contractor's inspection procedures, techniques, methods, acceptance criteria, and inspector qualifications for welding of steel Structures other than steel bridges shall be in accordance with AWS D1.1/D1.1M, latest edition, Structural Welding Code. The requirements described in the remainder of this section shall prevail whenever they differ from either of the above welding codes.

Nondestructive testing in addition to visual inspection shall be performed by the Contractor. Unless otherwise shown in the Plans or specified in the Special Provisions, the extent of inspection shall be as specified in this section. Testing and inspection shall apply to welding performed in the shop and in the field.

**Visual Inspection**

All welds shall be 100-percent visually inspected. Visual inspection shall be performed before, during, and after the completion of welding.

**Radiographic Inspection**

Complete penetration tension groove welds in Highway bridges shall be 100-percent radiographically inspected. These welds include those in the tension area of webs, where inspection shall cover the greater of these 2 distances: (a) 15-inches from the tension flange, or (b) ⅓ of the web depth. In addition, edge blocks conforming to the requirements of AASHTO/AWS D1.5M/D1.5:2002 Structural Welding Code Section 6.10.14 shall be used for radiographic inspection.

**Ultrasonic Inspection**

Complete penetration groove welds on plates thicker than 5⁄16-inch in the following welded assemblies or Structures shall be 100-percent ultrasonically inspected:

1. Welded connections and splices in Highway bridges and earth retaining Structures, excluding longitudinal butt joint welds in beam or girder webs.
2. Bridge bearings and modular expansion joints.
3. Sign bridges, cantilever sign Structures, and bridge mounted sign brackets excluding longitudinal butt joint welds in beams.
4. Light, signal, and strain pole standards, as defined in Section 9-29.6.

The testing procedure and acceptance criteria for tubular members shall conform to the requirements of the AWS D1.1/D1.1M latest edition, Structural Welding Code.

**Magnetic Particle Inspection**

1. Fillet and partial penetration groove welds:

   At least 30-percent of each size and type of fillet welds (excluding intermittent fillet welds) and partial penetration groove welds in the following welded assemblies or Structures shall be tested by the magnetic particle method:

   a. Flange-to-web connections in Highway bridges.
   b. End and intermediate pier diaphragms in Highway bridges.
   c. Stiffeners and connection plates in Highway bridges.
   d. Welded connections and splices in earth retaining Structures.
   e. Boxed members of trusses.

f. Bridge bearings and modular expansion joints.

g. Sign bridges, cantilever sign Structures, and bridge mounted sign brackets.

h. Light, signal, and strain pole standards, as defined in Section 9-29.6.

2. Longitudinal butt joint welds in beam and girder webs:

   At least 30-percent of each longitudinal butt joint weld in the beam and girder webs shall be tested by the magnetic particle method.

3. Complete penetration groove welds on plates 5/16-inch or thinner shall be 100-percent tested by the magnetic particle method. Testing shall apply to both sides of the weld, if backing plate is not used.

4. The ends of each complete penetration groove weld at plate edges shall be tested by the magnetic particle method.

Where 100-percent testing is not required, the Engineer reserves the right to select the location(s) for testing.

If rejectable flaws are found in any test length of weld in Item 1 or 2 above, the full length of the weld or 5-feet on each side of the test length, whichever is less, shall be tested.

After the Contractor's welding inspection is complete, the Contractor shall allow the Engineer sufficient time to perform quality assurance ultrasonic welding inspection.

The Contractor shall maintain the radiographs and the radiographic inspection report in the shop until the last joint to be radiographed in that member is accepted by the radiographer representing the Contractor. Within 2-working days following this acceptance, the Contractor shall mail the film and 2 copies of the radiographic inspection report to the Materials Engineer, Department of Transportation, PO Box 47365, Olympia, WA 98504-7365.

### 6-03.3(26) Screw Threads

Screw threads shall be U.S. Standard and shall fit closely in the nuts.

### 6-03.3(27) High Strength Bolt Holes

At the Contractor's option under the conditions described in this section, holes may be punched or subpunched and reamed, drilled or subdrilled and reamed, or formed by numerically controlled drilling operations.

The hole for each high strength bolt shall be 1/16-inch larger than the nominal diameter of the bolt.

In fabricating any connection, the Contractor may subdrill or subpunch the holes then ream full size after assembly or drill holes full size from the solid with all thicknesses of material shop assembled in the proper position. If the Contractor chooses not to use either of these methods, then the following shall apply:

1. Drill bolt holes in steel splice plates full size using steel templates.

2. Drill bolt holes in the main members of trusses, arches, continuous beam spans, bents, towers, plate girders, box girders, and rigid frames at all connections as follows:

   a. A minimum of 30-percent of the holes in 1 side of the connection shall be made full size using steel templates.

   b. A minimum of 30-percent of the holes in the second side shall be made full size assembled in the shop.

   c. All remaining holes may be made full size in unassembled members using steel templates.

3. Drill bolt holes in crossframes, gussets, lateral braces, and other secondary members full size using steel templates.

The Contractor shall submit for the Engineer's approval a detailed outline of the procedures proposed to accomplish the Work from initial drilling through shop assembly.

### 6-03.3(27)A Punched Holes

For punched holes, die diameter shall not exceed punch diameter by more than 1/16-inch. Any hole requiring enlargement to admit the bolt shall be reamed. All holes shall be cut clean with no torn or ragged edges. The Contracting Agency will reject components having poorly matched holes.

### 6-03.3(27)B Reamed and Drilled Holes

Reaming and drilling shall be done with short taper reamers or twist drills, producing cylindrical holes perpendicular to the member. Reamers and drills shall be directed mechanically, not hand-held. Connecting parts that require reamed or drilled holes shall be assembled and held securely as the holes are formed, then match-marked before disassembly. The Contractor shall provide the Engineer a diagram showing these match-marks. The Contracting Agency will reject components having poorly matched holes.

Burrs on outside surfaces shall be removed. If the Engineer requires, the Contractor shall disassemble parts to remove burrs.

If templates are used to ream or drill full-size connection holes, the templates shall be positioned and angled with extreme care and bolted firmly in place. Templates for reaming or drilling matching members or the opposite faces of 1 member shall be duplicates. All splice components shall be match-marked unless otherwise approved by the Engineer.

### 6-03.3(27)C Numerically Controlled Drilled Connections

In forming any hole described in Section 6-03.3(27), the fabricator may use numerically controlled (N/C) drilling or punching equipment if it meets the requirements in this subsection.

The Contractor shall submit for approval a detailed outline of proposed N/C procedures. This outline shall:

1. Cover all steps from initial drilling or punching through check assembly;
2. Include the specific members of the Structure to be drilled or punched, hole sizes, locations of the common index and other reference points, makeup of check assemblies, and all other information needed to describe the process fully.

N/C holes may be drilled or punched to size through individual pieces, or may be drilled through any combination of tightly clamped pieces.

When the Engineer requires, the Contractor shall demonstrate that the N/C procedure consistently produces holes and connections meeting the requirements ofthese Specifications.

### 6-03.3(27)D Accuracy of Punched, Subpunched, and Subdrilled Holes

After shop assembly and before reaming, all punched, subpunched, and subdrilled holes shall meet the following standard of accuracy. At least 75-percent of the holes in each connection shall permit the passage of a cylindrical pin ⅛-inch smaller in diameter than nominal hole size. This pin shall pass through at right angles to the face of the member without drifting. All holes shall permit passage of a pin 3⁄16-inch smaller in diameter than nominal hole size. The Contracting Agency will reject any pieces that fail to meet these standards.

### 6-03.3(27)E Accuracy of Reamed and Drilled Holes

At least 85-percent of all holes in a connection of reamed or drilled holes shall show no offset greater than 1⁄32-inch between adjacent thicknesses of metal. No hole shall have an offset greater than 1⁄16-inch.

Centerlines from the connection shall be inscribed on the template and holes shall be located from these centerlines. Centerlines shall also be used for accurately locating the template relative to the milled or scribed ends of the members.

Templates shall have hardened steel bushing inserted into each hole. These bushings may be omitted, however, if the fabricator satisfies the Engineer (1) that the template will be used no more than 5 times, and (2) that use will produce no template wear.

Each template shall be at least ½-inch thick. If necessary, thicker templates shall be used to prevent buckling and misalignment as holes are formed.

### 6-03.3(27)F Fitting for Bolting

Before drilling, reaming, and bolting begins, all parts of a member shall be assembled, well pinned, and drawn firmly together. If necessary, assembled pieces shall be taken apart to permit removal of any burrs or shavings produced as the holes are formed. The member shall be free from twists, bends, and other deformation.

In shop-bolted connections, contacting metal surfaces shall be sandblasted clean before assembly. Sandblasting shall meet the requirements of the SSPC Specifications for Commercial Blast Cleaning (SSPC-SP 6).

Any drifting done during assembly shall be no more than enough to bring the parts into place. Drifting shall not enlarge the holes or distort the metal.

### 6-03.3(28) Shop Assembly

### 6-03.3(28)A Method of Shop Assembly

Unless the Contract states otherwise, the Contractor shall choose 1 of the 5 shop assembly methods described below that will best fit the proposed erection method. The Contractor shall obtain the Engineer's approval of both the shop assembly and the erection methods before Work begins.

1. **Full Truss or Girder Assembly.** Each truss or girder is completely assembled over the full length of the Superstructure.
2. **Progressive Truss or Girder Assembly.** Each truss or girder is assembled in stages longitudinally over the full length of the Superstructure.
    a. For trusses: The first stage shall include at least 3 adjacent truss panels. Each truss panel shall include all of the truss members in the space bounded by the top and bottom chords and the horizontal distance between adjacent bottom chord Joints.

b. For girders: The first stage shall include at least 3 adjacent girder shop sections. Shop sections are measured from the end of the girder to the first field splice or from field splice to field splice.

c. For trusses and girders: After the first stage has been completed, each subsequent stage shall be assembled to include: 2 truss panels or girder shop sections of the previous stage (or 1 truss panel or girder shop section, if approved by the Engineer) and 1 or more truss panels or girder shop sections added at the advancing end. The previous stages shall be repositioned if necessary, and pinned to ensure accurate alignment. For straight sections of bridges without skews or tapers, girders in each subsequent stage may be assembled to include 1 girder shop section from the previous stage and 1 or more girder shop sections at the advancing end.

If the bridge is longer than 150-feet, each longitudinal stage shall be at least 150-feet long, regardless of the length of individual continuous truss panels or girder shop sections.

The Contractor may begin the assembly sequence at any point on the bridge and proceed in either or both directions from that point.

Unless the Engineer approves otherwise, no assembly shall have less than 3 truss panels or girder shop sections.

3. **Full Chord Assembly.** The full length of each chord for each truss is assembled with geometric angles at the joints. Chord connection bolt holes are drilled/reamed while members are assembled. The truss web member connections are drilled/reamed to steel templates set by relating geometric angles to the chord lines.

   At least 1 end of each web member shall be milled or scribed at right angles to its long axis. The templates at both ends of the member shall be positioned accurately from the milled end or scribed line.

4. **Progressive Chord Assembly.** Adjacent chord sections are assembled in the same way as specified for Full Chord Assembly, using the procedure specified for Progressive Truss or Girder Assembly.

5. **Special Complete Structure Assembly.** All structural steel members (Superstructure and Substructure, including all secondary members) are assembled at one time.

### 6-03.3(28)B Check of Shop Assembly

The Contractor shall check each assembly for alignment, accuracy of holes, fit of milled joints, and other assembly techniques. Drilling or reaming shall not begin until the Engineer has given approval. If the Contractor uses N/C drilling, this approval must be obtained before the assembly or stage is dismantled.

### 6-03.3(29) Vacant

### 6-03.3(30) Painting

All painting shall be in accordance with Section 6-07.

**6-03.3(30)A Vacant**

**6-03.3(30)B Vacant**

**6-03.3(30)C Erection Marks**

Erection marks to permit identification of members in the field shall be painted on previously painted surfaces.

**6-03.3(30)D Machine Finished Surfaces**

As soon as possible and before they leave the shop, machine-finished surfaces on abutting chord splices, column splices, and column bases shall be covered with grease. After erection, the steel shall be cleaned and painted as specified.

All surfaces of iron and steel castings milled to smooth the surface shall be painted with the primer called for in the specified paint system.

While still in the shop, machine-finished surfaces and inaccessible surfaces of rocker or pin-type bearings shall receive the full paint system. Surfaces of pins and holes machine-finished to specific tolerances shall not be painted. But as soon as possible and before they leave the shop, they shall be coated with grease.

**6-03.3(31) Alignment and Camber**

Before beginning field bolting, the Contractor shall:

1. Adjust the Structure to correct grade and alignment,
2. Regulate elevations of panel points (ends of floorbeams), and
3. Delay bolting at compression joints until adjusting the blocking to provide full and even bearing over the whole joint.

On truss spans, a slight excess camber will be permitted as the bottom chords are bolted. But camber and relative elevations of panel points shall be correct before the top chord joints, top lateral system, and sway braces are bolted.

**6-03.3(31)A Measuring Camber**

The Contractor shall provide the Engineer with a diagram for each truss that shows camber at each panel point. This diagram shall display actual measurements taken as the truss is being assembled.

**6-03.3(32) Assembling and Bolting**

To begin bolting any field connection or splice, the Contractor shall install and tighten to snug-tight enough bolts to bring all parts into full contact with each other prior to tightening these bolts to the specified minimum tension. “Snug-tight” means either the tightness reached by (l) a few blows from an impact wrench or (2) the full effort of a person using a spud wrench.

As erection proceeds, all field connections and splices for each member shall be securely drift pinned and bolted in accordance with 1 or 2 below before the weight of the member can be released or the next member is added. Field erection drawings shall specify pinning and bolting requirements that meet or exceed the following minimums:

1. **Joints in Normal Structures.** Fifty-percent of the holes in a single field connection and 50-percent of the holes on each side of a single joint in a splice plate shall be filled with drift pins and bolts. Thirty-percent of the filled holes shall be pinned. Seventy-percent of the filled holes shall be bolted and tightened to snug-tight. Once all these bolts are snug-tight, each bolt shall be

systematically tightened to the specified minimum tension. "Systematically tightened" means beginning with bolts in the most rigid part, which is usually the center of the joint, and working out to its free edges. The fully tensioned bolts shall be located near the middle of a single field connection or a single splice plate.

2. **Joints in Cantilevered Structures.** Seventy five-percent of the holes in a single field connection and 75-percent of the holes on each side of a single joint in a splice plate shall be filled with drift pins and bolts. Fifty-percent of the filled holes shall be pinned. Fifty-percent of the filled holes shall be bolted and tightened to snug-tight. Once all these bolts are snug-tight, each bolt shall be systematically tightened to the specified minimum tension. The fully tensioned bolts shall be located near the middle of a single field connection or a single splice plate.

Drift pins shall be placed throughout each field connection and each field joint with the greatest concentration in the outer edges of a splice plate or member being bolted.

To complete a joint following the method listed above, the Contractor shall fill all remaining holes of the field connection or splice plate with bolts and tighten to snug-tight. Once all of these bolts are snug-tight, each bolt shall be systematically tightened to the specified minimum tension. After these bolts are tightened to the specified minimum tension, the Contractor shall replace the drift pins with bolts tightened to the specified minimum tension.

The Contractor may complete a field bolted connection or splice in a continuous operation before releasing the mass of the member or adding the next member. The Contractor shall utilize drift pins to align the connection. The alignment drift pins shall fill between 15 and 30-percent of the holes in a single field connection and between 15 and 30-percent of the holes on each side of a single joint in a splice plate. Once the alignment drift pins are in place, all remaining holes shall be filled with bolts and tightened to snug-tight starting from near the middle and proceeding toward the outer gage lines. Once all of these bolts are snug-tight, the Contractor shall systematically tighten all these bolts to the specified minimum tension. The Contractor shall then replace the drift pins with bolts. Each of these bolts shall be tightened to the specified minimum tension.

All bolts shall be placed with heads toward the outside and underside of the bridge. All high-strength bolts shall be installed and tightened before the falsework is removed.

The Contractor may erect metal railings as erection proceeds. But railings shall not be bolted or adjusted permanently until the falsework is released and the deck placed.

The Contractor shall not begin painting until the Engineer has inspected and accepted field bolting.

### 6-03.3(33) Bolted Connections

Bolts, nuts, hardened washers, and direct tension indicators shall meet the requirements of Section 9-06.5(3).

All bolted connections are slip critical. Painted Structures require Type 1 or Type 2 bolts. Unpainted Structures require Type 3 bolts. AASHTO M 253 Type 1, 2, and 3 bolts shall not be galvanized or be used in contact with galvanized material.

Hardened washers are required under turned elements for connections using AASHTO M 164 and AASHTO M 253 bolts and, as required in the following:

1. Irrespective of the tightening method, hardened washers shall be used under both the head and the nut when AASHTO M 253 bolts are to be installed in structural carbon steel, as specified in Section 9-06.1.
2. Where the outer face of the bolted parts has a slope greater than 1:20 with respect to a plane normal to the bolt axis, a hardened beveled washer shall be used to compensate for the lack of parallelism.

All galvanized nuts shall be lubricated with a lubricant containing a visible dye so a visual check for the lubricant can be made at the time of field installation. Black bolts shall be "oily" to the touch when installed. Weathered or rusted bolts and nuts shall be cleaned and relubricated prior to installation.

After assembly, bolted parts shall fit solidly together. They shall not be separated by washers, gaskets, or any other material. Assembled joint surfaces, including those next to bolt heads, nuts, and washers, shall be free of loose mill scale, burrs, dirt, and other foreign material that would prevent solid seating.

When all bolts in a joint are tight, each bolt shall carry at least the proof load shown in Table 3 below:

**Table 3**
**Minimum Bolt Tension**

| Bolt Size (inches) | AASHTO M 164 (pounds) | AASHTO M 253 (pounds) |
|---|---|---|
| ½ | 12,050 | 14,900 |
| ⅝ | 19,200 | 23,700 |
| ¾ | 28,400 | 35,100 |
| ⅞ | 39,250 | 48,500 |
| 1 | 51,500 | 63,600 |
| 1⅛ | 56,450 | 80,100 |
| 1¼ | 71,700 | 101,800 |
| 1⅜ | 85,450 | 121,300 |
| 1½ | 104,000 | 147,500 |

Tightening may be done by either the turn-of-nut or the direct-tension indicator method. Preferably, the nut shall be turned tight while the bolt is prevented from rotating. However, if required because of bolt entering and/or wrench operational clearances, tightening may be done by turning the bolt while the nut is prevented from rotating. Following are descriptions of the turn-of-nut and direct-tension-indicator methods:

1. **Turn-of-Nut Method.** Hardened steel washers shall be used under the turned elements. After a bolt in a connection or joint splice plate has been tightened to snug-tight and all specified bolting conditions satisfied, it shall be tightened to the specified minimum tension by rotating the amount specified in Table 4. Before final tightening, the Contractor shall match-mark with crayon or paint the outer face of each nut and the protruding part of the bolt. To ensure that this tightening method is followed, the Engineer will (1) observe as the Contractor installs and tightens all bolts and (2) inspect each match-mark.

**Table 4**
**Turn-of-Nut Tightening Method Nut Rotational from Snug-Tight Condition**

| Bolt Length | Disposition of Outer Faces of Bolted Parts | | |
|---|---|---|---|
| | *Condition 1* | *Condition 2* | *Condition 3* |
| L <= 4D | ⅓-turn | ½-turn | ⅔-turn |
| 4D < L<= 8D | ½-turn | ⅔-turn | ⅚-turn |
| 8D < L<= 12D | ⅔-turn | ⅚- turn | 1-turn |

Bolt length measured from underside of head to top of nut.

*Condition 1* — both faces at right angles to bolt axis.

*Condition 2* — 1 face at right angle to bolt axis, 1 face sloped no more than 1:20, without bevel washer.

*Condition 3* — both faces sloped no more than 1:20 from right angle to bolt axis, without bevel washer.

Nut rotation is relative to the bolt regardless of which element (nut or bolt) is being turned. Tolerances permitted plus or minus 30-degrees (1/12-turn) for final turns of ½-turn or less; plus or minus 45-degrees (⅛-turn) for final turns of ⅔-turn or more.

D = nominal bolt diameter of bolt being tightened.

When bolt length exceeds 12D, the rotation shall be determined by actual tests in which a suitable tension device simulates actual conditions.

2. **Direct-Tension-Indicator Method.** DTIs shall not be used under the turned element. Direct-Tension-Indicators (DTIs) shall be placed under the bolt head with the protrusions facing the bolt head when the nut is turned. DTIs shall be placed under the nut with the protrusions facing the nut when the bolt is turned.

   DTIs shall be installed by 2 or more person crews with 1 individual preventing the element at the DTI from turning and measuring the gap of the DTI to determine the proper tension of the bolt.

   Three DTIs, per lot, shall be tested in a WSDOT approved bolt tension calibrator. The bolts shall be tensioned to 105-percent of the tension shown in Table 3. The test bolts shall not be tightened such that all of the DTI protrusions are completely crushed (all 5 openings with zero gap). The DTI gap between all protrusions shall be measured with a tapered feeler gage to the nearest 0.001-inch. All of the non-zero DTI gap measurements for the 3 test bolts shall be averaged. This average shall be used in the tightening of all the production bolts except as provided below.

   All bolts in a connection shall be snug tightened prior to bringing any DTIs in the connection to full load. The maximum gap of the production bolt DTIs shall not be greater than the average test gap established above or 0.005-inch, whichever is less. The minimum gap of the production bolt DTIs may be zero (all 5 openings with zero gap).

   The Contractor shall tension all bolts, inspecting all DTIs with a feeler gage, in the presence of the Engineer.

If a bolt, that has had its DTI brought to full load, loosens during the course of bolting the connection, the bolt shall have a new DTI installed and be retensioned. Reuse of the bolt and nut are subject to the provisions of this section.

AASHTO M 253 bolts and galvanized AASHTO M 164 bolts shall not be reused. Ungalvanized AASHTO M 164 bolts may be reused if approved by the Engineer. All bolts to be reused shall have their threads inspected for distortion by reinstalling the used nut on the bolt and turning the nut for the full length of the bolt threads by hand. Bolts to be reused shall be relubricated. Used bolts shall be subject to a rotational capacity test as specified in Section 6-03.3(33)A Pre-Erection Testing. Touching up or retightening previously tightened bolts which may have been loosened by the tightening of adjacent bolts shall not be considered as reuse, provided the snugging up continues from the initial position and does not require greater rotation, including the tolerance, than that required by Table 4.

### 6-03.3(33)A Pre-Erection Testing

High strength bolt assemblies (bolt, nut, and washer), black and galvanized, shall be subjected to a rotational capacity test (AASHTO M 164, Section 8.5) prior to any erection activity. Each combination of bolt production lot, nut lot, and washer lot shall be tested as an assembly. All tests shall be performed by the Contractor in the presence of the Engineer. Two specimens per lot shall be tested at the erection site immediately prior to installation, or whenever the Engineer deems it necessary. The bolt assemblies shall meet the following requirements.

1. Go through 2 times the required number of turns from snug tight condition as indicated in Table 4 of Section 6-03.3(33) without stripping, tensile, or shear failure. Rotation-capacity test shall be performed in a WSDOT approved bolt tension calibrator.
2. The maximum recorded tension shall be equal to or greater than 1.15 times the minimum bolt tension listed in Table 3 of Section 6-03.3(33).
3. The measured torque to produce the minimum bolt tension shall not exceed the value obtained by the following equation.

   Torque = 0.25 PD

   Where: Torque = Calculated Torque (foot-pounds)
   P = Measured Bolt Tension (pounds)
   D = Normal Bolt Diameter (feet)
4. Disassemble the torqued bolt and inspect for signs of failure. Failure is defined as any shear damage to the threads of the bolt or the nut or cracks in the body of the bolt. If either specimen fails, the lot of bolts will be rejected. Elongation of the bolt between the bolt head and the nut is not considered to be a failure.

### 6-03.3(33)B Bolting Inspection

The Contractor, in the presence of the Engineer, shall inspect the tightened bolt using an inspection torque wrench.

If the bolts to be installed are not long enough to fit in the Contracting Agency furnished tension calibrator, 5 bolts of the same grade, size, and condition as those under inspection shall be tested using Direct-Tension-Indicators (DTI) to measure bolt tension. This tension measurement test shall be done at least once each inspection day. The Contractor shall supply the necessary DTIs. The DTI shall be placed under the

bolt head. A washer shall be placed under the nut, which shall be the element turned during the performance of this tension measurement test. Each bolt shall be tightened by any convenient means to the specified minimum tension as indicated by the DTI. The inspecting wrench shall then be applied to the tightened bolt to determine the torque required to turn the nut 5-degrees (approximately 1-inch at a 12-inch radius) in the tightening direction. The job inspection torque shall be taken as the average of 3 values thus determined after rejecting the high and low values.

Five bolts (provided by the Contractor) of the same grade, size, and condition as those under inspection shall be placed individually in a Contracting Agency furnished tension calibrator to measure bolt tension. This calibration operation shall be done at least once each inspection day. There shall be a washer under the part turned in tightening each bolt if washers are used on the Structure. In the calibrated device, each bolt shall be tightened by any convenient means to the specified tension. The inspecting wrench shall then be applied to the tightened bolt to determine the torque required to turn the nut or head 5-degrees (approximately 1-inch at a 12-inch radius) in the tightening direction. The job-inspection torque shall be taken as the average of 3 values thus determined after rejecting the high and low values.

Ten-percent (at least 2) of the tightened bolts on the Structure represented by the test bolts shall be selected at random in each connection. The job-inspection torque shall then be applied to each with the inspecting wrench turned in the tightening direction. If this torque turns no bolt head or nut, the Contracting Agency will accept the connection as being properly tightened. But if the torque turns 1 or more bolt heads or nuts, the job-inspection torque shall then be applied to all bolts in the connection. Any bolt whose head or nut turns at this stage shall be tightened and reinspected. The Contractor may, however, retighten all the bolts in the connection and resubmit it for inspection.

### 6-03.3(34) Adjusting Pin Nuts

All pin nuts shall be tightened thoroughly. The pins shall be placed so that members bear fully and evenly on the nuts. The pins shall have enough thread to allow burring after the nuts are tightened.

### 6-03.3(35) Setting Anchor Bolts

Anchor bolts shall be set in masonry as required in Section 6-02.3(18). Anchor bolts shall be grouted in after the shoes, masonry plates, and keeper plates have been set and the span or series of continuous spans are completely erected and adjusted to line and camber.

### 6-03.3(36) Setting and Grouting Masonry Plates

The following procedure applies to masonry plates for all steel spans, including shoes, keeper plates, and turning racks on movable bridges.

To set masonry plates, the Contractor shall:

1. Set masonry plates on the anchor bolts;
2. Place steel shims under the masonry plates to position pin centers or bearings to line and grade and in relationship to each other. Steel shims shall be no more than 2½-inches square and placed under plate webs;
3. Level the bases of all masonry plates;
4. Draw anchor bolt nuts down tight;
5. Recheck pin centers or bearings for alignment; and
6. Leave at least ¾-inch of space under each masonry plate for grout.

After the masonry plates have been set and the span or series of continuous spans are completely erected and swung free, the space between the top of the masonry and the top of the concrete bearing seat shall be filled with grout. Main masonry plates for cantilever spans shall be set and grouted in before any steel Work is erected.

Grout mixture and placement shall be as required in Section 6-02.3(20).

### 6-03.3(37) Setting Steel Bridge Bearings

Masonry plates, shoes, and keeper plates of expansion bearings shall be set and adjusted to center at a normal temperature of 64ºF. Adjustment for an inaccuracy in fabricated length shall be made after dead-load camber is out.

### 6-03.3(38) Placing Superstructure

The Contractor shall place no Superstructure load on finished piers or abutments until the Engineer allows. Normally, this concrete-hardening interval requires at least 12-days.

### 6-03.3(39) Swinging the Span

No forms, steel reinforcing bars, or concrete roadway slabs shall be placed on steel spans until the spans swing free on their supports and elevations recorded. No simple span or any series of continuous spans will be considered as swinging free until all temporary supports have been released. Forms, reinforcing steel, or concrete roadway slabs shall not be placed on any simple or continuous span steel girder bridge until all its spans are adjusted and its masonry plates, shoes, and keeper plates grouted. For this Specification, the Structure shall be considered as continuous across hinged joints.

After the falsework is released (spans swung free) the masonry plates, shoes, and keeper plates are grouted, and before any load is applied, the Engineer will (or, if the Contractor is specified as responsible for surveying, the Contractor shall) measure elevations at the tenth points along the tops of girders and floorbeams.

The Engineer will compare steel mass camber elevations with the elevations measured above, and will furnish the Contractor with new dead-load camber dimensions.

### 6-03.3(40) Draining Pockets

The Contractor shall provide enough holes to drain all water from pockets in trusses, girders, and other members. Unless shown on approved shop plans, drain holes shall not be drilled without the written approval of the Engineer.

All costs related to providing drain holes shall be included in the unit Contract prices for structural or cast steel.

### 6-03.3(41) Floorbeam Protection

Each floorbeam that supports a concrete slab joint shall be coated on its top and flange edges with a heavy mop of roofing grade asphalt, applied hot. This asphalt shall conform to ASTM D 312 (not mineral stabilized). A protective covering of asphalt coated glass fiber sheet (ASTM D 4601 Type 1 non-perforated) shall be placed over the hot coat of asphalt. This combination coating shall be applied over the shop paint. It shall take the place of the 2 field coats of paint specified for other parts of the structural steel.

### 6-03.3(42) Surface Condition

As the Structure is erected, the Contractor shall keep all steel surfaces clean and free from dirt, concrete, mortar, oil, paint, grease, and other stain-producing foreign matter. Any surfaces that become stained shall be cleaned as follows:

Painted steel surfaces shall be cleaned by methods required for the type of staining. The method shall be submitted to the Engineer for approval.

Unpainted steel surfaces shall be cleaned by sandblasting. Sandblasting to remove stains on publicly visible surfaces shall be done to the extent that, in the Engineers opinion, the uniform weathering characteristics of the Structure are preserved.

### 6-03.3(43) Castings, Steel Forgings, and Miscellaneous Metals

Castings, steel forgings, and miscellaneous metals shall be built to comply with Section 9-06.

### 6-03.3(43)A Shop Construction, Castings, Steel Forgings, and Miscellaneous Metals

This section's requirements for structural steel (including painting requirements) shall also apply to castings, steel forgings, and miscellaneous metals.

Castings shall be:

1. True to pattern in form and dimensions;
2. Free from pouring faults, sponginess, cracks, blow holes, and other defects in places that would affect strength, appearance, or value;
3. Clean and uniform in appearance;
4. Filleted boldly at angles; and
5. Formed with sharp and perfect arises.

Iron and steel castings and forgings shall be annealed before any machining, unless the Plans state otherwise.

### 6-03.4 Measurement

Structural carbon steel, structural low alloy steel, and structural high strength steel will not be measured but will be paid for on a lump sum basis as described in Section 6-03.5.

Cast or forged metal (kind) or copper seals shown in the Plans will be measured by the pound or will be paid for on a lump sum basis, whichever is shown on the Proposal.

### 6-03.5 Payment

Payment will be made in accordance with Section 1-04.1, for each of the following Bid items that are included in the Proposal:

"Structural Carbon Steel", lump sum.

The lump sum Contract price for "Structural Carbon Steel" shall be full pay for all costs in connection with furnishing all materials, labor, tools, and equipment necessary for the manufacture, fabrication, transportation, erection, and painting of all structural carbon steel used in the completed Structure, including the providing of such other protective coatings or treatment as may be shown in the Plans or specified in the Special Provisions.

For steel Structures, the estimated weight of the structural carbon steel in the project will be shown in the Plans or in the Special Provisions. In the event any change in the Plans is made which will affect the weight of materials to be furnished, payment for the additional structural carbon steel required as a result of the change in the Plans will be made at a unit price per pound obtained by dividing the Contractor's lump sum Bid for structural carbon steel by the total estimated weight of structural carbon steel shown in the Plans or in the Special Provisions.

Reductions in weight due to a change in the Plans will be made at the same rate as determined above and will be deducted from payments due the Contractor.

Prospective Bidders shall verify the estimated weight of structural carbon steel before submitting a Bid. No adjustment other than for approved changes will be made in the lump sum Bid even though the actual weight may deviate from the stated estimated weight.

For concrete and timber Structures, where the structural carbon steel is a minor item, no estimated weight will be given for the structural carbon steel. In the event any change in the Plans is necessary which will affect the weight of material to be furnished for this type of Structure, the payment or reduction for the revision in quantity will be made at a unit price per pound obtained by dividing the Contractor's lump sum Bid for the structural carbon steel by the calculated weight of the original material. The calculated weight will be established by the Engineer and will be based on an estimated weight of 490-pounds per cubic foot for steel.

Any change in the Plans which affects the weight of material to be furnished as provided herein will be subject to the provisions of Section 1-04.4.

"Structural Low Alloy Steel", lump sum.

"Structural High Strength Steel", lump sum.

Payment for "Structural Low Alloy Steel" and "Structural High Strength Steel" will be made on the same lump sum basis as specified for structural carbon steel.

"(Cast or Forged) Steel", lump sum or per pound.

"(Cast, Malleable, or Ductile) Iron", lump sum or per pound.

"Cast Bronze", lump sum or per pound.

Payment for "(Cast or Forged) Steel", "(Cast, Malleable or Ductile) Iron", and "Cast Bronze" will be made at the lump sum or per pound Contract prices as included in the Proposal.

For the purpose of payment, such minor items as bearing plates, pedestals, forged steel pins, anchor bolts, field bolts, shear connectors, etc., unless otherwise provided, shall be considered as structural carbon steel even though made of other materials.

When no Bid item is included in the Proposal and payment is not otherwise provided, the castings, forgings, miscellaneous metal, and painting shall be considered as incidental to the construction, and all costs therefore shall be included in the unit Contract prices for the payment items involved and shown.